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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/927,428	08/09/2001	Wenbing Yun	LBL-IB-1498	6387

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John P. O'Banion
O' BANION & RITCHEY LLP
Suite 1550
400 Capitol Mall
Sacramento, CA 95814

EXAMINER

DEO, DUY VU NGUYEN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 02/20/2003

9

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/927,428

Applicant(s)

YUN ET AL.

Examiner

DuyVu n Deo

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-80 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-80 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 1, 2, 7-11, 16, 18, 23, 28, 29, 34-38, 40, 41, 43, 45, 50, 55, 60, 61, 63, 64, 66, 67, 69, 71, 76 are rejected under 35 U.S.C. 102(b) as being anticipated by Zandveld (US 4,104,085).

Zandveld describes a method for etching a substrate comprising: bombarding the surface of the wafer having a silicon (di)oxide layer with argon ions having energy of at least 20 keV with the depth depending on the ions concentration and energy (claimed irradiating the wafer surface with a charged particle beam of suitable energy) and this would form claimed particle tracks; forming a pattern photoresist on the irradiated wafer surface; etching the wafer with a solution according to the etching pattern (col. 3, line 50-col. 4, line 50; figure 1-5).

Referring to claims 2, 10, 29, 37, 38, 55, 63, 64 figure 2 shows the charged particle beam is of predetermined collimation and at a desired direction (perpendicular) with respect to the wafer surface.

Referring to claim 9, the argon ions are used for the ion implantation (col. 3, line 64-68). This would read on claimed charged particle beam is produced by removing some or all electron from neutral atoms. Method, such as using an accelerator, to produce such ions are known by one skilled in the art as shown in page 9, line 1-2 of specification.

Referring to claims 13, 40, 66 figure 2 shows that the particle tracks would be formed substantially parallel to each other. Claims 14, 41, 67 do not have patentable weight because it is an optional limitation.

3. Claims 1-4, 7, 8, 10, 14, 16, 18, 28-31, 34, 35, 37, 41, 43, 45, 55-57, 60, 61, 63, 67, 69, 71 are rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. (US 6,271,127).

Liu describes a method for forming dual damascene comprising: exposing the substrate surface with and electron beam or ion implantation with suitable energy (claimed irradiating the wafer surface with a charged particle beam of suitable energy) and this would form claimed particle tracks with a desired depth and alignment; depositing and developing a resist to form an etching pattern on the wafer (claimed depositing and removing portions of the resist layer to generate an etching pattern on the wafer); etching the wafer according to the etching pattern (col. 7, line 21-44; col. 8, line 20-30).

Referring to claims 2, 10, 29, 37, 55, 63, even though Liu is silent about the charged particle beam is of predetermined collimation and at a desired direction with respect to the wafer surface, the electron beam or ion implantation would have to carry a certain collimation and at a certain direction (claimed predetermined collimation at a desired direction) with respect to the wafer surface. Claims 14, 41, 67 do not have patentable weight because it is an optional limitation.

Referring to claims 3, 4, the wafer would comprise a negative of a final nanomachined structure for the depositing of metal interconnection (col. 7, line 51-59).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 9, 11, 13, 36, 38, 40, 62, 64, 66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu as applied to claims 1, 10, 28, 37, 55, 63 above, and further in view of Zandveld (US 4, 104,085).

The ion implantation taught by Liu is known to one skilled in the art. Zandveld describes such ion implantation method using argon ions (col. 3, line 64-68). This would read on claimed charged particle beam is produced by removing some or all electron from neutral atoms. Method, such as using an accelerator, to produce such ions are known by one skilled in the art as shown in page 9, line 1-2 of specification.

Referring to claims 11, 13, 38, 40, 64, 66 figure 2 from Zandveld shows the direction is perpendicular to the wafer surface and the particle tracks formed would be substantially parallel to each other

6. Claims 15, 17, 19-22, 42, 44, 46-49, 68, 70, 72-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Zandveld as applied to claims 1, 28, 55 above, and further in view of Hashimoto et al. (US 4,976,818).

The process of forming pattern in the photoresist is known to one skilled in the art as describes here by Hashimoto. This process include spin coating, electron beam exposure, and develop in a solvent (col. 2, line 46-54).

Hashimoto also teaches using multi-layer resist system because it improves dry etch resistance and suppress the proximity effect due to reflection of electrons. The multi resist system is processed with dissolution of selective portions of the resist layer using a solvent and a plasma based etching (col. 1, line 18-31; summery; col. 2, line 39-61).

7. Claims 23-25, 50-52, 76-78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu as applied to claims 1, 28, 55 above, and further in view of applicant's admitted prior art.

Referring to claim 23, Liu is silent about the chemistry being used for etching of the wafer. Method for etching the wafer including an etching solution or plasma is well known to one skilled in the art as described in page 13 of the specification. Therefore, at the time of the invention, using any method will be obvious in order to etch the wafer with a reasonable expectation of success.

8. Claims 5, 6, 26, 27, 32, 33, 53, 54, 58, 59, 79, 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Liu/admitted prior art as applied to claims 1, 25, 28, 52, 57, 78 above, and further in view of Chen (US 5, 723,387).

Liu doesn't describe the electroplating method for forming the Cu. Chen teaches an electroplating method for forming Cu interconnects (claims 6, 7). It would have been obvious for one skilled in the art to deposit Cu in light of Chen because Chen teaches that electroplating method can form very small scale Cu interconnects on semiconductor substrate.

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9. Claims 12, 39, 65 rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Zandveld as applied to claims 10, 37, and 63 above.

Unlike claimed invention, Liu and Zandveld do not describe the direction of the particle beam hitting the substrate is of less than 90 degrees with respect to the plane of the wafer surface. However, the amount of particle beam hitting the wafer surface would depend on the angle it hits on the wafer; therefore, it would have been obvious for one skilled in the art to determine the angle the particle beam hitting the wafer surface through routine experimentation in order to obtain the optimum angle for the wafer surface treatment with a reasonable expectation of success.

Claim Rejections - 35 USC § 112

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

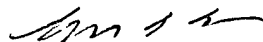
11. Claims 23, 50, 76 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation "etching pattern...with aspect ratio substantially greater than that in etching pattern" is vague and unclear to what exactly being compared.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DuyVu n Deo whose telephone number is 703-305-0515.

DVD

February 11, 2003



BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700